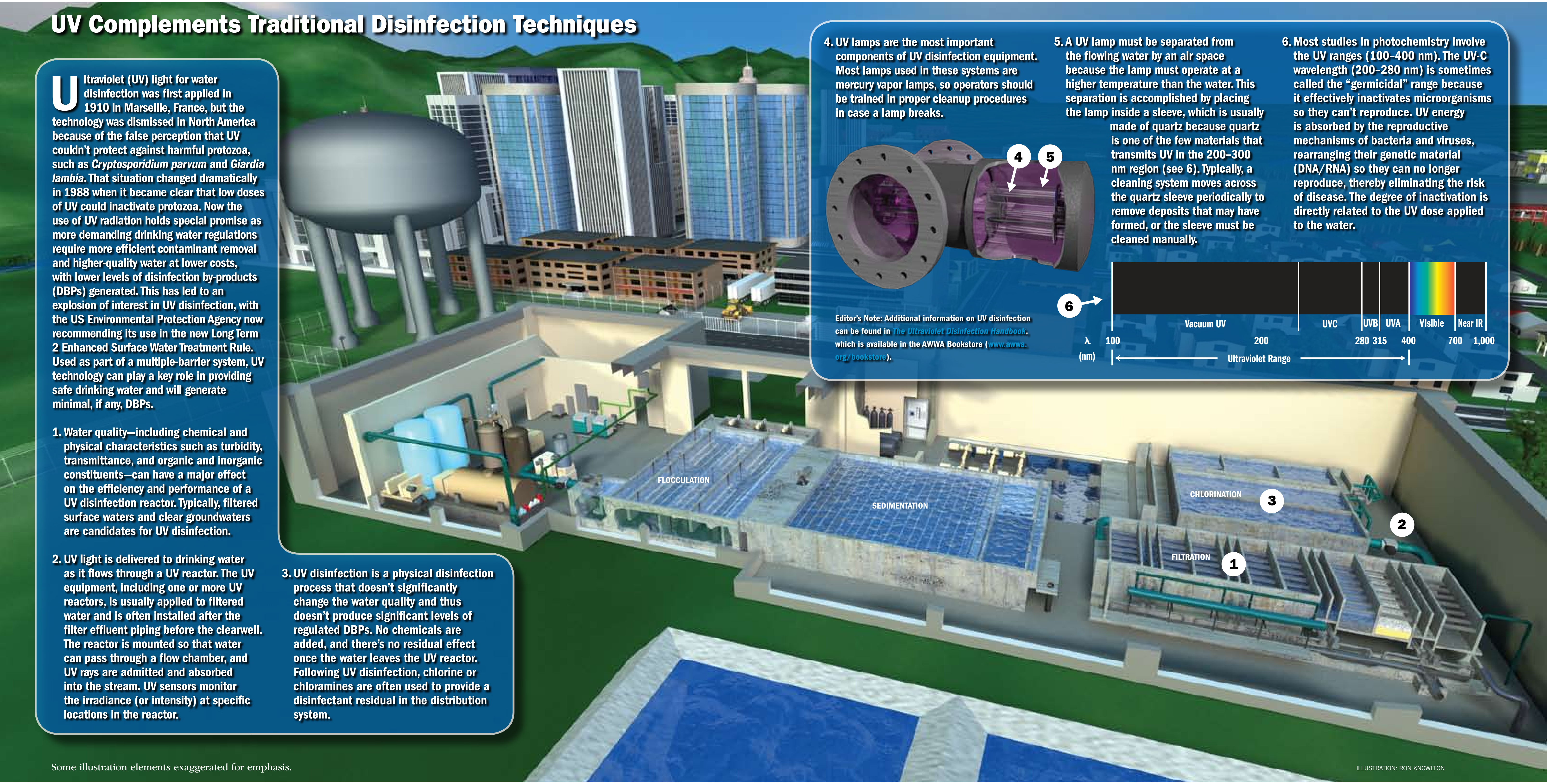
How Water Works

ILLUSTRATED PROCESSES, EQUIPMENT, AND TECHNOLOGY

UV Complements Traditional Disinfection Techniques



Ultraviolet (UV) light for water disinfection was first applied in 1910 in Marseille, France, but the technology was dismissed in North America because of the false perception that UV couldn't protect against harmful protozoa, such as *Cryptosporidium parvum* and *Giardia lambia*. That situation changed dramatically in 1988 when it became clear that low doses of UV could inactivate protozoa. Now the use of UV radiation holds special promise as more demanding drinking water regulations require more efficient contaminant removal and higher-quality water at lower costs, with lower levels of disinfection by-products (DBPs) generated. This has led to an explosion of interest in UV disinfection, with the US Environmental Protection Agency now recommending its use in the new Long Term 2 Enhanced Surface Water Treatment Rule. Used as part of a multiple-barrier system, UV technology can play a key role in providing safe drinking water and will generate minimal, if any, DBPs.

1. Water quality—including chemical and physical characteristics such as turbidity, transmittance, and organic and inorganic constituents—can have a major effect on the efficiency and performance of a UV disinfection reactor. Typically, filtered surface waters and clear groundwaters are candidates for UV disinfection.

2. UV light is delivered to drinking water as it flows through a UV reactor. The UV equipment, including one or more UV reactors, is usually applied to filtered water and is often installed after the filter effluent piping before the clearwell. The reactor is mounted so that water can pass through a flow chamber, and UV rays are admitted and absorbed into the stream. UV sensors monitor the irradiance (or intensity) at specific locations in the reactor.

3. UV disinfection is a physical disinfection process that doesn't significantly change the water quality and thus doesn't produce significant levels of regulated DBPs. No chemicals are added, and there's no residual effect once the water leaves the UV reactor. Following UV disinfection, chlorine or chloramines are often used to provide a disinfectant residual in the distribution system.

4. UV lamps are the most important components of UV disinfection equipment. Most lamps used in these systems are mercury vapor lamps, so operators should be trained in proper cleanup procedures in case a lamp breaks.

5. A UV lamp must be separated from the flowing water by an air space because the lamp must operate at a higher temperature than the water. This separation is accomplished by placing the lamp inside a sleeve, which is usually made of quartz because quartz is one of the few materials that transmits UV in the 200–300 nm region (see 6). Typically, a cleaning system moves across the quartz sleeve periodically to remove deposits that may have formed, or the sleeve must be cleaned manually.

6. Most studies in photochemistry involve the UV ranges (100–400 nm). The UV-C wavelength (200–280 nm) is sometimes called the "germicidal" range because it effectively inactivates microorganisms so they can't reproduce. UV energy is absorbed by the reproductive mechanisms of bacteria and viruses, rearranging their genetic material (DNA/RNA) so they can no longer reproduce, thereby eliminating the risk of disease. The degree of inactivation is directly related to the UV dose applied to the water.

Editor's Note: Additional information on UV disinfection can be found in *The Ultraviolet Disinfection Handbook*, which is available in the AWWA Bookstore (www.awwa.org/bookstore).

Some illustration elements exaggerated for emphasis.

ILLUSTRATION: RON KNOWLTON

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